has come from Spain and Africa instead of from the Atlantic, as in the west. But as the result of observations of temperature in the upper air I have latterly thought that Mr. Harries's suggestion is correct, and that the high temperature is due to a descending current. So far as my recollection goes, the phenomenon occurs when an anticyclone is situated over France or the south-east of England, and not in cyclonic conditions such as have prevailed during the past week.

Whatever the cause may be, the temperatures and pressures of the air from 2000 ft. to 25,000 ft. are most highly correlated; from 10,000 ft. to 20,000 ft. the correlation coefficients between temperatures and pressures at the same height are as high as 0·80 to 0·90, and even at 2000 ft. the temperature is far more dependent upon the pressure at 30,000 ft. than it is upon the direction of the wind. Above 35,000 ft. the correlation is negative. It seems pretty clear that this close connection between temperature and pressure must be due to vertical currents induced by the distribution of pressure; it is too close, and above 30,000 ft. of the wrong sign, to be accounted for by the mere adiabatic compression and expansion without change of height, and it may well be that on some occasions the descending currents reach the surface and produce a high temperature, although in general the temperature at the surface is not much influenced by the pressure. W. H. DINES.

Benson, January 10.

Cyclones.

"J. S. D.," in his interesting article in NATURE for January 2 last, makes the following statement:—"Thus the cyclone was looked upon as a warm column of rising air with spirally inflowing winds at its base; the anticyclone, conversely, contained a cold core of descending air. Now we know that the opposite is in reality the truth; the cyclone has a cold core, the anticyclone a warm one." I think it should be pointed out that this pronouncement is only correct for the troposphere, but not for the stratosphere.

Modern methods of sounding the atmosphere have shown that the Arctic and Antarctic cyclones have warm centres in the stratosphere, and Dines (Met. Office Pub., 210*b*, p. 50) shows that this is true of travelling cyclones also.

Too much importance has been attached to the temperature distribution in the lower portion of the troposphere. Modern discoveries have merely located the hot core of the cyclone in the stratosphere instead of in the troposphere, leaving the temperature theory still the cause of the cyclonic circulation of the wind and the force that lifts up a cool central column of air from the ground.

I think it will be found that the energy of cyclones can be maintained on the temperature theory with a very slight interchange of air between the stratosphere and troposphere in the case of the polar cyclones, and in the case of travelling cyclones by the bodily rising of the air in the central regions during their comparatively brief life.

R. MOUNTFORD DEELEY.

25 Beaconsfield Villas, Brighton, January 4.

MR. R. M. DEELEY is quite right in pointing out that it is only in the troposphere that depressions are relatively cold and anticyclones warm. It is in this region that the striking contrast appears between the old preconceived theory which postulated a warm core and the results of modern observation. The mechanism by which a cyclonic depression is maintained in being forms one of the great unsolved problems in meteorology. Some years ago the suggestion was put forward by Mr. W. H. Dines that the driving force of the depression was to be looked for in the level at the base of the stratosphere. According to this view, a very slowly descending, and therefore warmed, column of air in the stratosphere is just such an integral part of the whole system as the rising, and therefore cold, column in the troposphere, but neither the one nor the other is to be regarded as the cause of the depression. Mr. Deeley may be right in his view that the warm column in the upper layers is the fundamental cause, but this view is not at present generally accepted.

J. S. D.

The Brussels Natural History Museum.

To many of your readers who appreciate the value of the collections in the Brussels Museum, the following extract from a letter written by Dr. Dollo on January 5 will be welcome news:—"Mais je vous avais écrit également une carte postale illustrée, représentant notre Galerie des Vertébrés vivants et fossiles de la Belgique, pour vous dire que tout était bien ici, que *notre Musée est intact*, qu'il n'y manque absolument rien, et que nous étions saufs!"

A. C. SEWARD.

Downing College Lodge, Cambridge,
January 12.

BORINGS FOR OIL IN THE UNITED KINGDOM.

THERE is no need to labour the importance of liquid fuel in our national economy and existence. The growing needs of our Navy and Air Service, and the difficulties of transport during the war, have driven home the lesson and rendered imperative the demand that we should increase to a maximum the output of liquid fuels in the British Isles. The present production, mainly from the Scotch oil-shales and some of the coal-tar distillates, is very inadequate, and the country has had to depend almost entirely on foreign supplies. Such a state of affairs is obviously deplorable, and if remedies are possible the neglect to apply them would be highly culpable. Two methods of alleviating the situation have been suggested, and both are being tried. The first entails the extensive retorting of British oil-shales and cannels to produce oil by destructive distillation; the second involves the drilling of wells in selected areas in a search for free crude petroleum in commercial quantities. With the first method the present writer is not here concerned; it is the attempt to find oil in the free state which forms the subject of the ensuing remarks.

The generally received opinion, that Nature, so lavish in her gifts of coal and iron to these favoured islands, was unaccountably frugal with petroleum, has not been accepted by all. A small minority has urged, and recently with insistence, that the assumption is based largely on the absence of definite intelligent exploratory drilling—that we are, in fact, in the same position as the United States before the Drake well of 1859, ignorant of the great stores of wealth lying available below the surface.

If this view be sound its importance cannot be over-estimated; if it be only possible it is well worth investigation; if it be absurd the importance of the issue renders it necessary that it should be seriously confuted. It must be admitted that the history of scientific opinion affords numerous instances of truths finally prevailing against the hostility of accepted opinion. It is perhaps not to be wondered at that in consideration of its urgent needs the Government should have resolved to put the matter to the practical test. But it by no means follows that a commercial supply of oil will be forthcoming, in spite of the sanguine dreams and hopes of those who have pronounced favourably on the project. Petroleum is an unusually elusive substance, and the records of its development teem with "wild-cat" schemes, some of them successful, most of them failures, but all of them graced with the blessings of some sober expert. The very term "wild-catting" is a recognised name in oil technology for exploratory drilling of a purely speculative nature based on little or no evidence; the present scheme comes definitely within the limits of the term.

It must be asserted at the outset that the general public report of the whole project has given an unduly optimistic account of the views of men of science on the problem. The measure of its success will be judged, as in any commercial undertaking, by the returns. Nothing short of the promised oil-fields would be an adequate return. The bulk of informed geological opinion —and the problem is essentially geological—is, to say the least, sceptical. It will therefore be well at this stage to sum up the evidence in order to ascertain what justification there is for the position of those numerous geologists who, in spite of, or rather in consequence of, their knowledge of the structure and geological history of the country, have been in the past, and still remain, unconvinced as to the likelihood of the existence of large supplies of oil therein.

Apart from a few exceptional cases, the oil-fields of the world can be divided into two main groups, those in rocks of Tertiary and Upper Cretaceous age, and those of Palæozoic age. The former are situated along the trend of the Tertiary geosynclinals; they are usually affected by folding movements, sometimes intensely folded and thrust, and generally show abundant surface indications of their contained petroleum. A few important exceptions occur, such as the Mexican and Gulf States fields, where there is little folding, and surface evidence of the hydrocarbons is often absent. These exceptions are in their structures more allied to the Palæozoic fields. The latter are largely confined to North America; they range in age from the Ordovician to the Carboniferous; folding is either absent or is of a gentle, open nature, and the presence of surface indications of petroleum is exceptional.

In Britain the Tertiaries would not be seriously considered as a possible source of petroleum in large quantities. Their extent is limited, their structures are in the main synclinal, and they have been riddled by wells in a search for water. Neither do the Mesozoic strata yield indications of a more hopeful character. The claims of Dr. Forbes Leslie of abundance of free oil in the Jurassic strata near the Wash have been negatived by the work of all other investigators. It is to the Carboniferous system of the Palæozoics that most attention has been directed as the possible source of petroleum. The indications of this material are too numerous to mention here in detail. An excellent account of them will be found in W. H. Dalton's paper on "The Oil Prospects of the British Isles,"[1] and a further summary is contained in a recent publication by H.M. Geological Survey on "Lignites, Jets, Kimmeridge Oil-shales, Mineral Oil, Cannel Coals, and Natural Gas."[2] Most of these petroleum occurrences are insignificant and ephemeral; they range over the whole gamut from solid asphalt to natural gas. In a few cases, however, the supply of oil has been sufficient to be exploitable on a small scale, though only for a limited period. Thus at the Riddings Colliery, Derbyshire, a yield of oil averaging about 300 gallons a week was obtained for some years, and was the primary cause of the development of the Scotch oil-shale industry.

Judging by what has been published on the subject, it is to be presumed that the extensive scheme which has been inaugurated is largely based on the selection of suitable areas where Carboniferous rocks with suitable structures either outcrop or will be reached at convenient depths. The initial test near Chesterfield is obviously based on this principle. The sandstones of the Millstone Grit series and the porous horizons of the Upper Carboniferous Limestone will be available porous reservoir rocks, while the Coal Measures and Pendleside Shales will be relied on to constitute the overlying impervious strata which are essential to prevent the oil from escaping. The basis, then, of the project is simple. It rests on the numerous small indications of natural hydrocarbons the majority of which have been located in the Carboniferous strata, and it relies on the location of suitable geological structures for test-wells. Other formations will probably be tested, but presumably the main reliance will be placed on the Carboniferous.

Having now considered the guiding principles of any search for free oil in this country, it remains to discuss the possibilities of success. It will be generally agreed that the *bona-fide* petroleum indications are quite numerous, though they are mainly insignificant. Further, it will be conceded that in many, if not in most, cases they are examples of natural crude petroleum or asphalt, as distinct from the products of destructive distillation from coal seams by local igneous metamorphism, though examples of this action are quite common. Moreover, it will be admitted that there are suitable anticlinal structures for oil concentration, and abundance of porous strata to contain the liquid material. To strengthen the main argument, analogies are drawn by those in favour of the project between the Palæozoic oil-fields of North America and the corresponding strata in Great Britain, and emphasis is laid on the supposed association of coal and oil—an association which is the exception rather than the rule, and is of very doubtful significance. Further support is sought in the curious theory propounded by Mr. E. H. C. Craig that the Scotch shale-fields are essentially an old oil-field in which the petroleum has become inspissated, has combined with the clay, and has produced the valuable seams of shale which form the raw product of the industry.[3]

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[1] Journal of the Institution of Petroleum Technologists, vol. iv., No. 13, p. 37, 1917.

[2] Mem. Geol. Survey. Special Reports on the Mineral Resources of Great Britain, vol. vii., part i., p. 41, 1918.

At first sight this body of evidence appears by no means negligible, and there are numerous oil-fields which have been founded on more slender data. It is only when we examine the negative evidence that a true perspective is obtained and that the reasons for a pessimistic attitude become apparent. To begin with, the numerous evidences of petroleum in Britain are neither surprising nor abnormal; they are merely examples of the general rule that petroleum in small quantities is almost universal, particularly in sedimentary rocks. Britain, with its wealth of strata, representing all phases of marine and terrestrial conditions, would undoubtedly contain examples of such a widespread material. There is a world of difference, however, between a small patch of oil and a large accumulation. One represents the result of a process of organic decomposition which is not uncommon; the other entails this process on a much larger scale, and involves in addition an accompanying or succeeding phase of conditions favouring the concentration and preservation of this material. This association of essential independent conditions on a large scale is necessarily a much less common event.

Secondly, the parallel drawn between the Pennsylvanian and other Palæozoic fields of the United States and the British Carboniferous is not merely misleading; it is untrue. The cases are not parallel; they are opposite. For in all these oil-fields in the older strata the distinctive feature which requires explanation is not the formation of the oil, but its preservation from the dispersive effects of denudation. The outstanding feature of these Palæozoic oil-fields of America is the absence of strong folds and faults; the structures are either terraced, or broad open folds with dips generally below 5°. When the Appalachian oil-fields approach the areas of more pronounced folding the oil disappears. It is not suggested that oil does not occur in strongly folded strata; on the contrary, this is quite common in the Tertiary oil-fields; but it is maintained that such structures are incapable of preserving the elusive fluid in commercial quantities for long geological periods when the rocks are jointed, faulted, and folded, and the subsequent denudation is extensive. The blanketing effect of the overlying formations must be extremely effective to prevent the dispersion of the oil, and in this particular the folded and faulted structures of the British Carboniferous and their extensive dissection render them in no sense comparable with the altogether abnormal structures of the Palæozoic oil-fields of North America.

With the theory that the Scotch shale-fields are relics of an old oil-field the writer does not propose to deal. It accords with neither the geological nor the chemical data, and does not require serious controversy.

That a true estimate of the whole problem may be obtained, it is necessary to consider briefly the primary conditions for the occurrence of oil in commercial quantities. These involve three main factors: the formation of large quantities of the material, its migration into suitable reservoirs of porous rocks, and its preservation in these reservoirs from complete dispersion by volatilisation or by denudation. With reference to the formation of the material, it is now generally admitted that the origin of the oil is primarily organic; further, it may be confidently stated that the balance of evidence strongly supports a marine habitat. Such marine conditions with abundant remains of organic life decomposing under anaerobic conditions have certainly occurred in the geological history of these islands. Neither was there any paucity of suitable reservoir rocks and structures to guide the concentration of the petroleum. It is the preservation of the material from dispersion and loss which presents the whole difficulty. This will be fully appreciated by those conversant with the folded and faulted character of the Carboniferous rocks and the extensive denudation to which they have been subjected since their deposition. This denudation extended over the long terrestrial period of the later Palæozoics and the early Mesozoics, and was followed by a second period of erosion extending from early Tertiary times to the present. This intense dissection of the Carboniferous folds, rifted as they are with important fault systems, has given every opportunity for the oil to effect its escape.

In conclusion, it may be pointed out that in general the widespread Tertiary oil-fields have been largely folded by orogenic movements of Middle Tertiary age. The subsequent erosion, though in the geological sense quite short, has been sufficient in many cases to allow already a natural escape of the hydrocarbons to the surface, and man is busy tapping the remaining resources before Nature has completed the task. The American Palæozoic fields owe their preservation to unique structure and protection from erosion. The British Carboniferous strata, those in which the prospects have been considered to be most favourable, are much more strongly folded and faulted than their equivalents in the American oil-fields, and their dissection is much greater. The whole evidence of the geology, and the cumulative experience of the smallness and ephemeral nature of any oil occurrences which have been noted, agree in indicating that large commercial underground supplies of petroleum do not exist in this country. Small deposits have been found in the past, and will no doubt be found in the future, but the present search for large commercial supplies is not justified by the scientific evidence, though there is no doubt that the bores will yield useful scientific data. V. C. ILLING.

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[3] "Kerogen and Kerogen Shales." Journal of the Institution of Petroleum Technologists, vol. ii., pp. 238–73, 1916.

THE BRITISH DYE INDUSTRY.

THE report, in the *Times* of January 6, of the annual meeting of shareholders in Levinstein's, Ltd., held on December 23, contains one important announcement—namely, that the long-contemplated amalgamation of the company with the Government company known as "British Dyes, Ltd.," is now practically an accomplished fact. The new company is to be called the "British Dyestuffs Corporation, Ltd."

As reported in NATURE of December 5 last, a scheme had been adopted by the President of the Board of Trade in response to a memorandum presented by the Association of Chemical Manufacturers urging the desirability of a more general utilisation of the industrial and scientific resources of the country, and avoidance of overlapping and competition. The White Paper which contains the scheme was summarised in NATURE of November 21 last.

As a result of the amalgamation of the two great companies, an important step has been taken in the direction of presenting a more united front in the great commercial struggle which will in all probability begin so soon as Germany assumes a more settled condition. At the present time the outlook is less formidable for the British colour-maker than it was before the armistice, as the economic position of Germany will continue for some time to be more than doubtful. Labour will undoubtedly command higher wages, raw materials will not be so freely at the disposal of German manufacturers, competition in America and other countries is developing, and there is a widespread reluctance on the part of the Allied nations to resume business relations with the Central Powers severally or collectively.

On the other hand, the works and appliances of the German firms remain substantially undiminished in extent and unimpaired as to organisation, while they still possess a large body of expert chemists and engineers fully acquainted with the details of the business, though doubtless there have been serious losses in the course of the war. It is, however, satisfactory to learn from the address of Lord Armaghdale, the chairman of Levinstein's, that, in his opinion, provided sufficient financial support is forthcoming, this country may be rendered independent of German dyestuffs. On the scientific side, he added, success is certain. There is in this country a larger amount of chemical talent than has hitherto been recognised, and during the war many university professors and others occupied with purely scientific research have given valuable assistance to the colour industry, as well as in other departments of manufacture.

Considering the difficulties to be overcome in the revival of chemical industries in this country at the beginning of the war, and, as compared with Germany, the serious lack of organisation and of scientifically trained assistance, the success so far achieved is encouraging in the highest degree. There is no justification for the gloomy view of the situation sometimes taken, and if the scheme now working under the Board of Trade is not perfect, it is, at any rate, a step in the right direction, and has been accepted by the dye-makers and the dye-users.

The trade and licensing committee referred to in the scheme has now been constituted under Lord Colwyn as chairman. The following are the other members: Mr. Henry Allen, Mr. Milton Sharp, and Mr. Lennox B. Lee, nominated by the Colour Users' Committee; Mr. T. Taylor, representing the paint and varnish manufacturers; Dr. Herbert Levinstein and Mr. J. Turner, nominated jointly by British Dyes, Ltd., and Levinstein's, Ltd.; Mr. W. J. Uglow Woolcock, M.P., nominated by the Association of British Chemical Manufacturers; and Mr. W. H. Dawson, nominated by the President of the Board of Trade. The Commissioner for Dyes, Sir Evan Jones, M.P., will be an *ex officio* member without a vote. Dr. H. Levinstein is the well-known managing director of Levinstein's, Ltd., and he will control the scientific and manufacturing operations of the new corporation resulting from the fusion of British Dyes and Levinstein's. Mr. J. Turner has been a director of British Dyes, Ltd., for several years, and he will be largely influential in the business arrangements of the conjoint firms.

The functions of the committee now constituted will be to determine the colours and intermediates which shall be licensed for import into the United Kingdom after the conclusion of peace, and to advise the Commissioner for Dyes as to the colours and intermediates the manufacture of which in this country should be specially encouraged.

It is satisfactory to find that the Port Ellesmere indigo factory has been in full work for some time, and that land has been secured for considerable extensions of the works in the near future.

THE PRELIMINARY EDUCATION OF MEDICAL STUDENTS.

THE education committee of the General Council of Medical Education and Registration has presented a report on "The Nature of the Recognition to be Extended to the Schools Examinations recently established by the Board of Education in England." It will be remembered that the English Board of Education has established two "schools examinations," to be known respectively as the "first" and "second," or "higher," examination, the former for pupils of about sixteen years of age, and the latter for those a year or two older. The standard of the former is to be such that a "pass with credit" would entitle the candidate to admission to a university, and a slightly lower standard should be accepted for an ordinary pass. The "second